1: Circulation. 1996 Nov 1;94(9 Suppl):II164-8.

Tissue-engineered heart valves. Autologous valve leaflet replacement study in a lamb model.

Shinoka T, Ma PX, Shum-Tim D, Breuer CK, Cusick RA, Zund G, Langer R, Vacanti JP, Mayer JE Jr.

Department of Cardiovascular Surgery, Children's Hospital, Boston, Mass, USA.

BACKGROUND: We have previously reported the successful creation of tissue-engineered valve leaflets and the implantation of these autologous tissue leaflets in the pulmonary valve position. This study was designed to trace cultured cells that were seeded onto a biodegradable polymer with the use of a 1,1'-dioctadecyl-3,3,3' 3'-tetramethylindo-carbocyanine perchlorate (Di-1) cell-labeling method. We also examined the time-related biochemical, biomechanical, and histological characteristics and evolution of these tissue constructs. METHODS AND RESULTS: Mixed cell populations of endothelial cells and fibroblasts were isolated from explanted ovine arteries. Endothelial cells were selectively labeled with an acetylated low density lipoprotein marker and separated from fibroblasts with the use of a fluorescence-activated cell sorter. A synthetic biodegradable scaffold consisting of polyglycolic acid fibers was seeded first with fibroblasts, then coated with endothelial cells. Using these methods, we implanted autologous cell/polymer constructs in six animals. In two additional control animals, a leaflet of polymer was implanted without prior cell seeding. In each animal, cardiopulmonary bypass was used to completely resect the right posterior leaflet of the pulmonary valve and replace it with an engineered valve leaflet with (n = 6) or without (n = 2) prior cultured cell seeding. The animals were killed either after 6 hours or after 1, 6, 7, 9, or 11 weeks, and the implanted valve leaflets were examined histologically, biochemically, and biomechanically. 4-Hydroxyproline assays were performed to determine collagen content. Leaflet strength was evaluated in